FIS Architecture Study Plan

JHU/APL

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Outline

- Study Background
  - NASA/Glenn Tasking
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- Architecture Process
  - Schedule
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  - Technology
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  - Scoring
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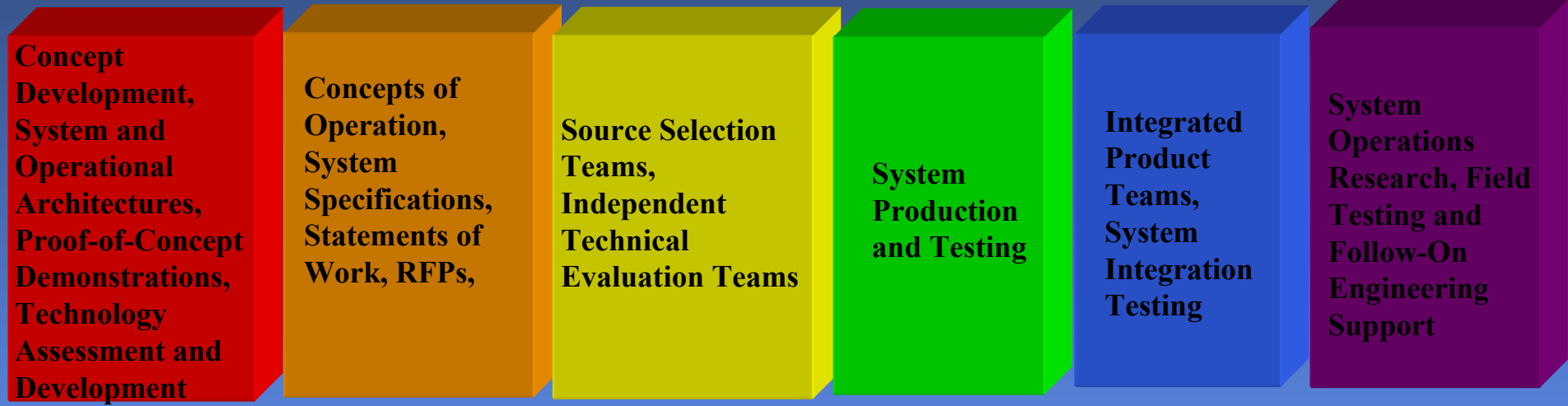
NASA/Glenn Tasking

- NASA/Glenn has tasked APL to “support the investigation of systems and architectures, currently under development, that have the potential to support the dissemination of timely weather information to aircraft”
  - VDL Mode-4, Mode-S (1090), UAT modeling/simulation for TAMDAR (EPIREP) and FIS-B
  - FIS architecture: independent assessment to determine a single optimum WINCOMM architecture
- Focused on 2007 - 2015 implementations
- Period of performance - 9 months

Applied Physics Laboratory

- Not-for-profit university research and development laboratory
- Division of The Johns Hopkins University founded in 1942
- Staffing: 3,300 employees
  105 subcontractors
  (64% scientists & engineers)
- Annual commitment level:
  ~$500M (75% DoD)

APL Communications System Development Spectrum



- Army FCS
- Turbo Code Software Radio
- Turbo CPM
- SATCOM Planning Integration
- SATCOM for Missile Defense
- Multifunction Buoyant Cable Array

- AEHF Terminal Control CONOPS
- SATCOM for JCTN
- WAMS

- ADS-B Link Eval.
- MUOS AoA
- Teleports AoA
- Advanced EHF Crypto. System

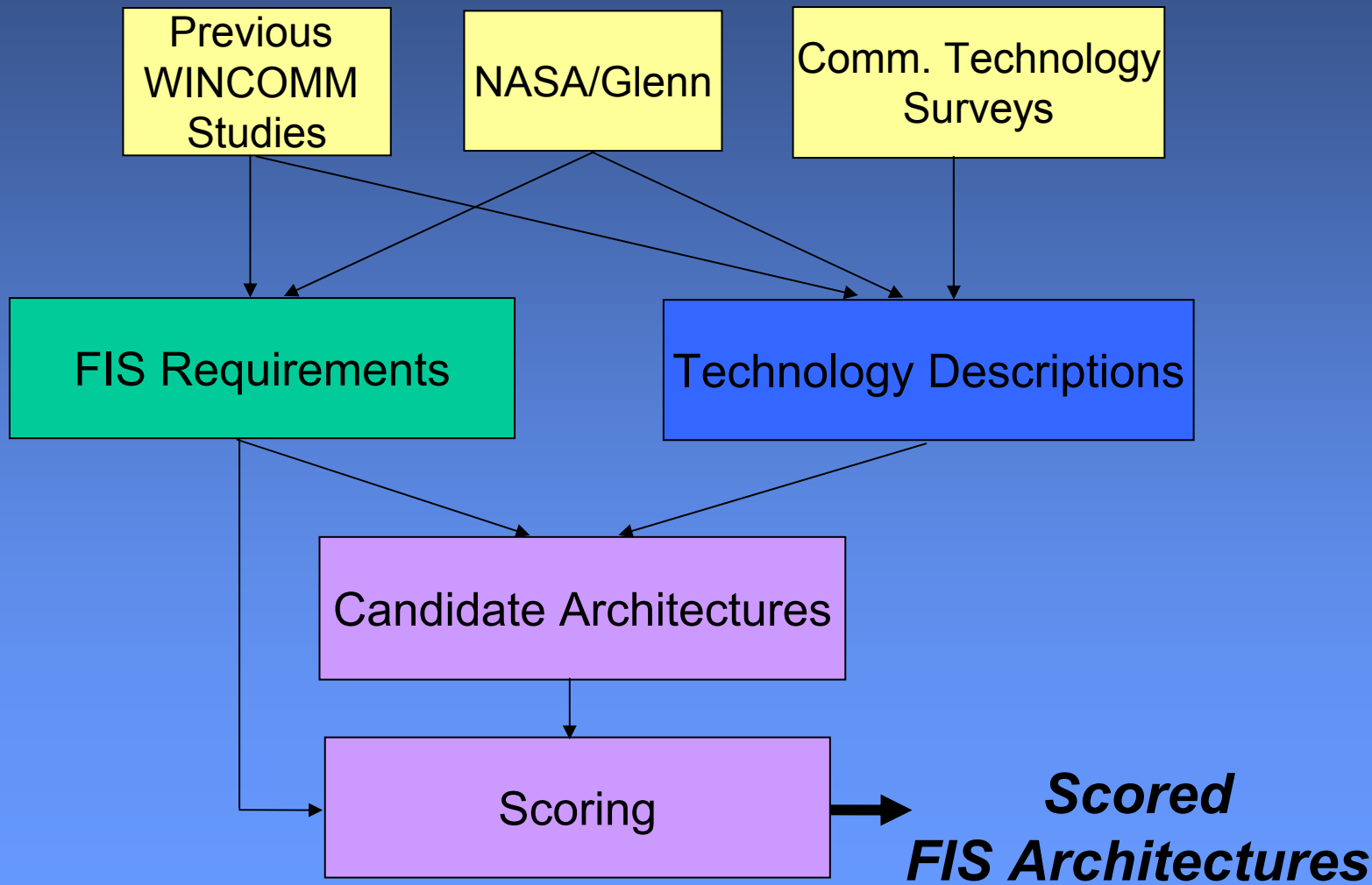
- DIMS
- ODOCS
- Polar EHF
- Wavelet Compressed Video

- CNPS
- IMPCS
- NASA TDRS
- Tactical Tomahawk

- CEC Range Extension
- NESP MDR Terminal Testing
- FBM & SCAP

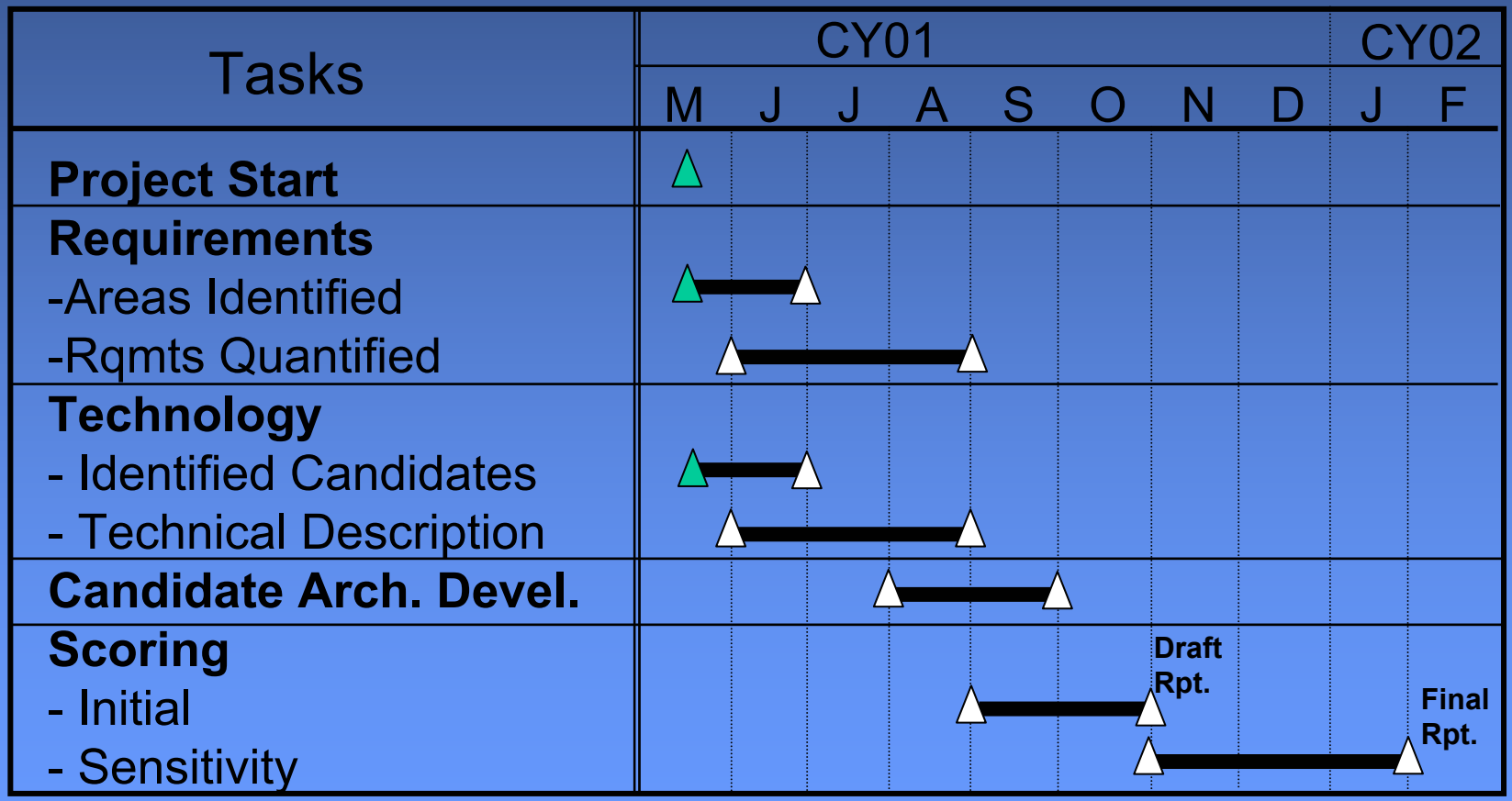
(Selected Programs)

Architecture Assessment Process



High-Level Schedule

Draft



Requirements

- The assessment of WINCOMM architectures will require a precise description of requirements
- Requirements will be generated from:
  - Existing studies when possible
  - NASA/Glenn and APL in cases of new requirement areas
- The requirement areas to be considered will include (in no specific order):
  - Capacity
    - What are the information exchange requirements?
    - What are the per aircraft and aggregate data rates to be supported?
  - Connectivity/Topology
    - What topology will be suitable/achievable for WINCOMM (e.g., hub/spoke, flat)?

Requirements (cont'd)

- Requirements areas (cont'd)
  - Number of elements
    - How many aircraft must be supported in the architecture?
    - How many other elements (ground nodes) are required?
  - Platform constraints
    - What aircraft constraints exist in terms of size/power/weight?
    - What ground node constraints exist?
  - Coverage
    - Is global or regional coverage required?
    - Will requirements change with aircraft flight phase?
  - Link availability
    - What is the expected percentage of time that the link will need to be available?
    - Is this characterized by successful message receipt?

Requirements (cont'd)

- Requirements areas (cont'd)
  - Latency
    - What are the required timing constraints on information receipt?
    - How does this vary by information type, aircraft type and flight phase?
  - Cost
    - What is the targeted aircraft cost?
    - What are the constraints on infrastructure cost?
  - Traffic type
    - Is the traffic expected to be continuous or bursty?
    - If bursty, what are appropriate statistics?
  - Protection
    - Should the link information be encrypted and/or protected in particular ways?

Technology

- Technologies will be identified from previous studies and APL surveys
- Possibilities include both LOS and SATCOM systems projected to be mature in the time frame of interest
- All possess advantages and disadvantages. Examples:
  - Existing aviation links may have lower cost due to current equipage and infrastructure
  - SATCOM provides large coverage and broadcast capabilities
  - Cellular infrastructure in place but coverage limitations exist
  - Etc.

Technology (cont'd)

Example Technologies for Consideration

- Aviation Links
  - ADS-B candidates
    - VDL Mode 4
    - Mode S "1090"
    - UAT
  - ACARS
  - EFAS
  - VDL Modes 2 & 3

- Satellite Communications
  - GEO/MEO/LEO constellations
  - S-DARS

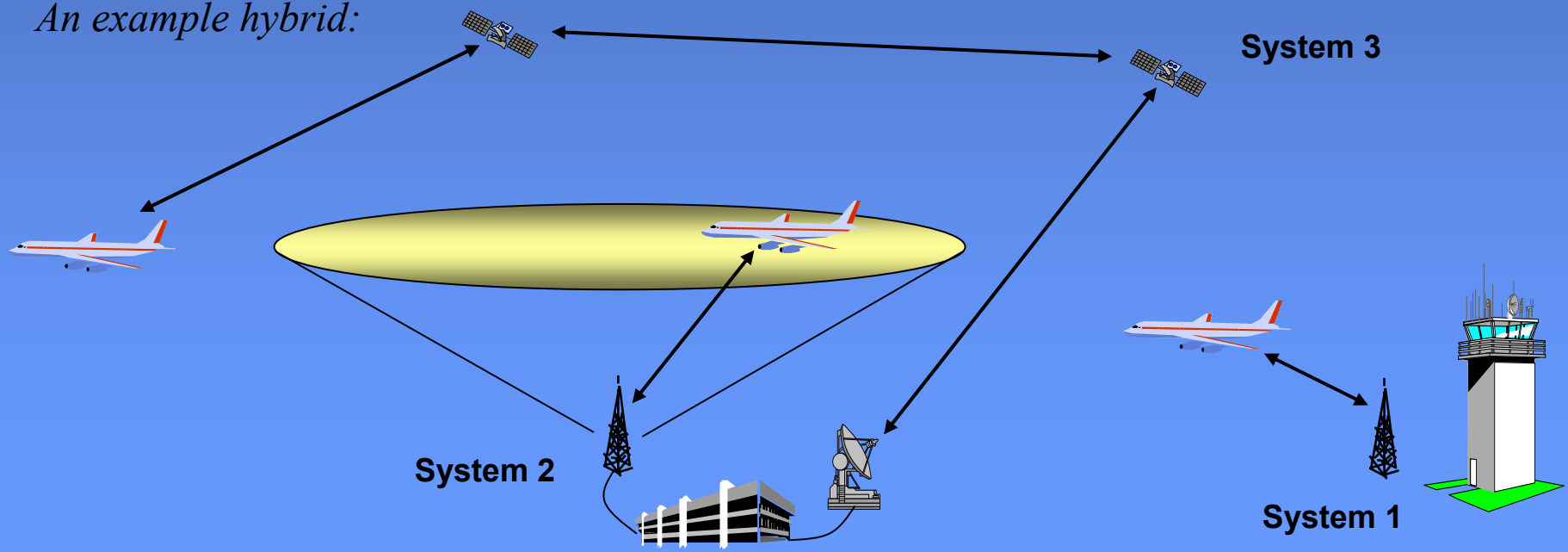
- Cellular Networks
  - AMPS
  - IS-95
  - GSM
  - UMTS

- Related Technologies
  - Compression
  - Software-Defined Radios

Candidate Architectures

- Architectures will be developed using the technologies with input from the requirements
- Architectures may consist of a single communications technology or hybrid concepts

An example hybrid:



Scoring

- Scoring necessary for two reasons:
  - To quantitatively determine the ability of an architecture to support each requirement (quantify the advantages and disadvantages)
  - To combine the varied requirements into a single score for ranking purposes
- Quantitative approach will be developed by APL and NASA/Glenn
- Sensitivity analysis will be conducted to examine the dependencies of different scorings and weightings
- Similar approaches used by APL in recent DoD Analysis of Alternatives

Summary

- Goal of task is to determine the best communications architecture to support FIS
- A process has been developed to enable an independent assessment while leveraging the substantial investments already made